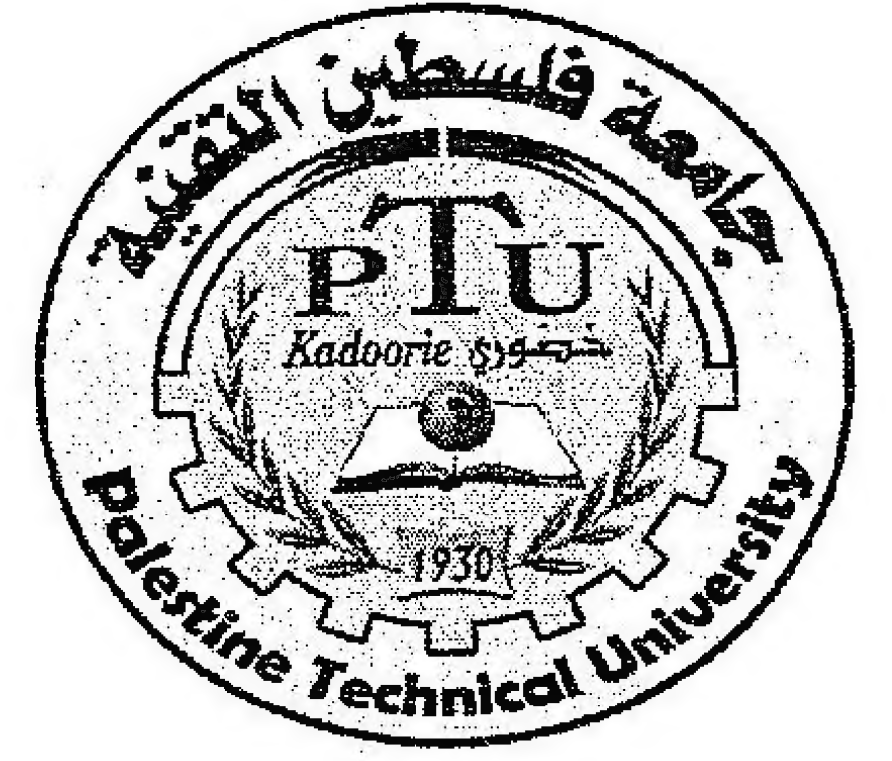


88
100

Statics
Second



STATICS

اسم المساق :

12 December 2010

تاريخ الامتحان :

11.00-11.50

زمن الامتحان :

50 minutes

الامتحانات الفصلية الثانية

57
65

الاسم: مهن سلام عقشان

التخصص: (ميكاترونكس) - كهرباء

INSTRUCTIONS TO CANDIDATES

Read the questions carefully and

Answer QA1 and QA2 and only ONE question from section B.

To get a full mark, you need to show all work out clearly in all cases

You may use a scientific calculator

تم الرفع بواسطة م. مهن أبو عيسى

Section A – Answer BOTH questions in this section

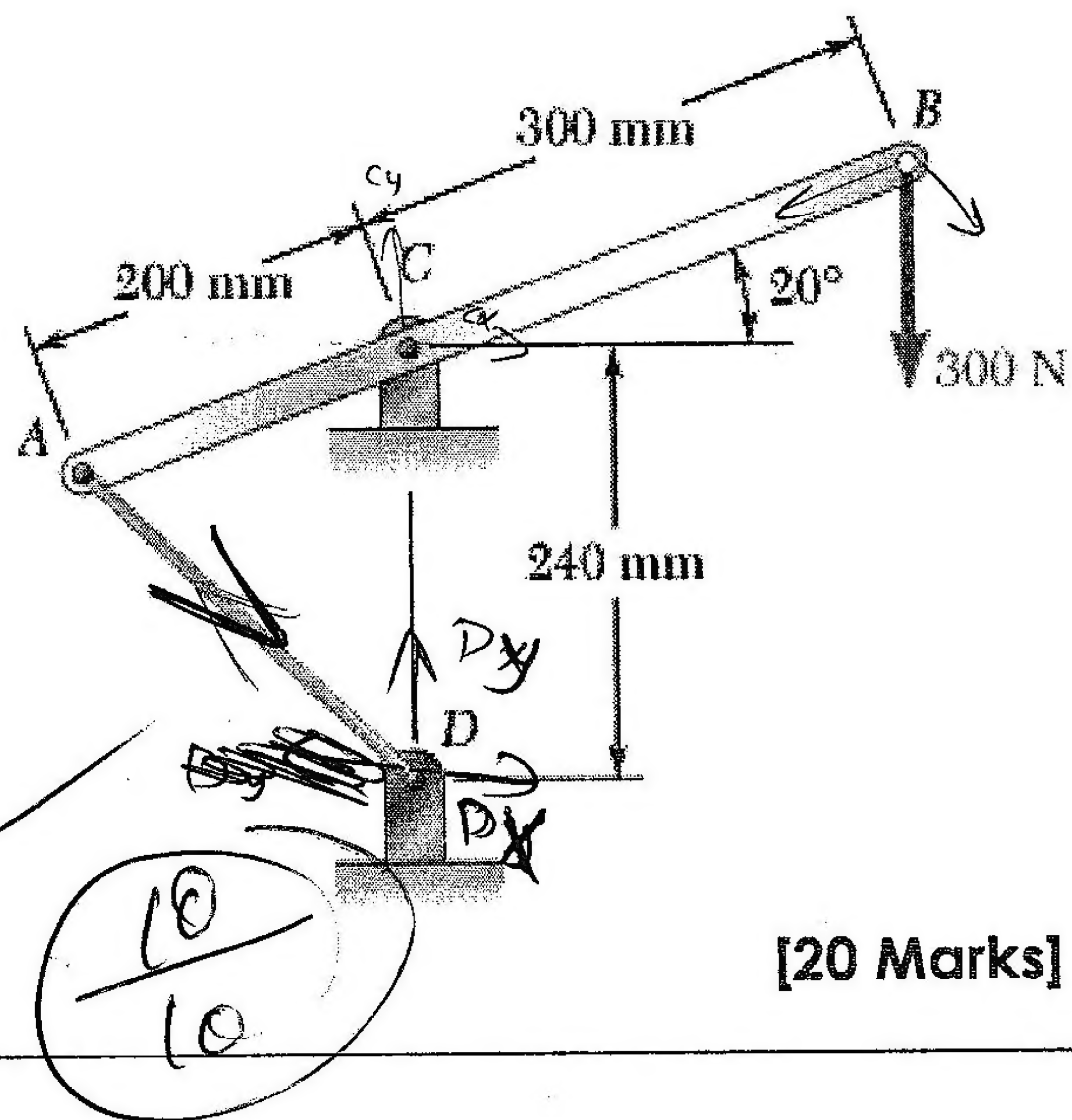
QA1

A rigid lever AB is hinged at C and is attached to a control cable at A. If the lever is subjected to a 300-N vertical force at B, determine:

- The tension in the cable,
- The reaction at C.

Choose one of the following answers:

- $T = 47 \text{ N}$, $C = 71 \text{ N}$ @ 63.5° with Horiz.
- $T = 47.7 \text{ N}$, $C = 71.5 \text{ N}$ @ 61.5° with Horiz.
- $T = 477 \text{ N}$, $C = 715 \text{ N}$ @ 60.5° with Horiz.
- $T = 677 \text{ N}$, $C = 7105 \text{ N}$ @ 67.5° with Horiz.
- $T = 477 \text{ N}$, $C = 715 \text{ N}$ @ 64.5° with Horiz.



Ans.

$$\sum M_C = 0$$

$$-300(300 \cos 20^\circ)$$

$$\sum M_C = 0$$

$$-300(300 \cos 20^\circ) + A(200 \cos 20^\circ) = 0$$

$$-84572.3 + 187.9A \Rightarrow A = \frac{+84572.3}{+187} = 452 \text{ N}$$

$$\downarrow 477 \text{ N}$$

$$\sum M_D = 0$$

$$-300(300 \cos 20^\circ) +$$

$$C = \sqrt{C_x^2 + C_y^2} =$$

$$\phi = \tan^{-1} \left(\frac{C_y}{C_x} \right) \Rightarrow \tan^{-1} \left(\frac{300}{C_x} \right) = 60.5^\circ$$

$$1.76 = \frac{300}{C_x} \Rightarrow C_x = 170$$

$$C_x = 170 \text{ N}$$

$$C_y = 300 \text{ N}$$

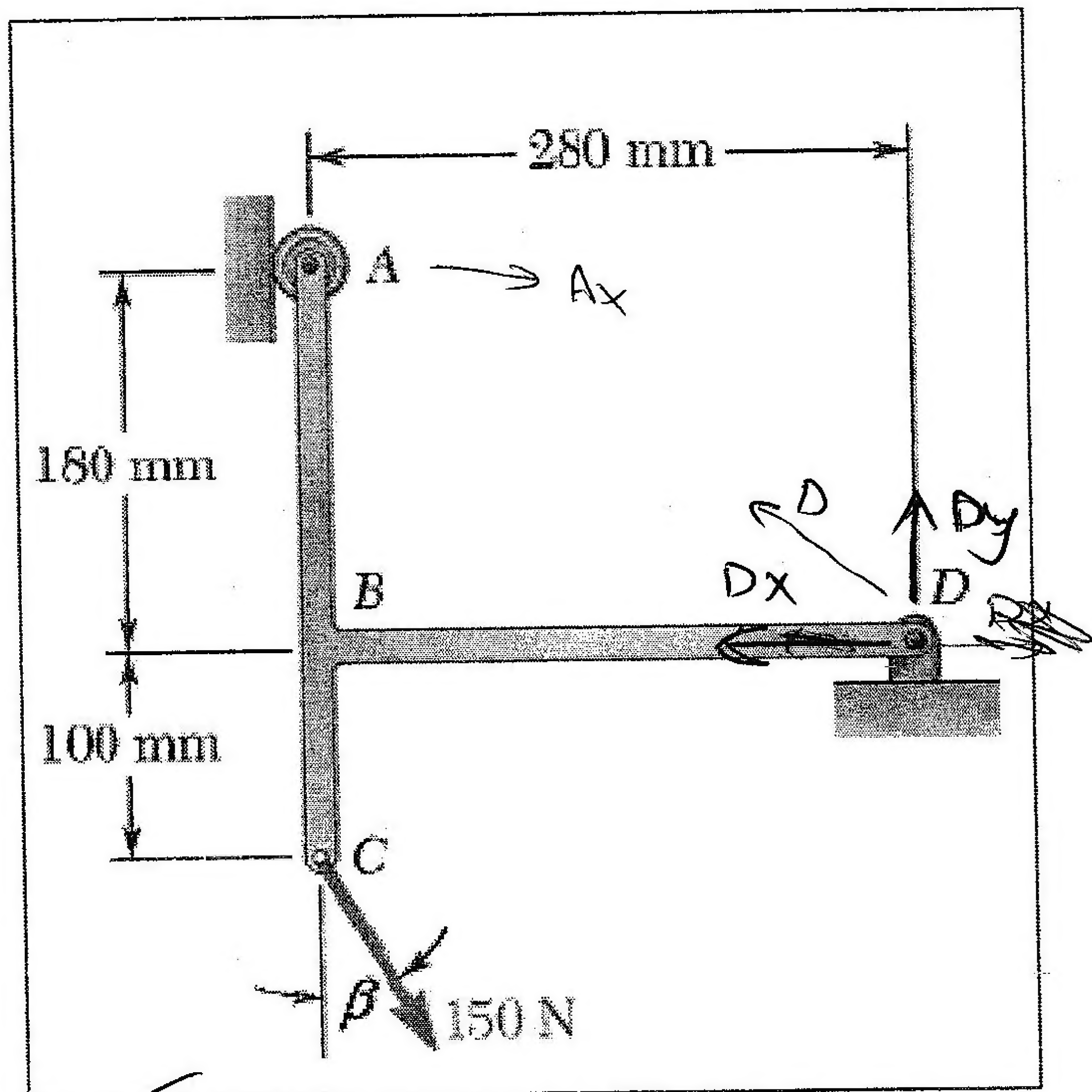
QA2

A rigid structure ABCD is supported by a pin joint at end D while end A is attached to a roller which is resting against a rigid wall as shown. In equilibrium position, ABC is held vertical while BC is horizontal. The structure is subjected to a force of 150 N at end C, making an angle of 25° with the vertical.

For this structure, determine (a) the reaction at A (b) the reaction at D

Choose one of the following options:

1. $A = 244.7 \text{ N} \rightarrow$, $D = 344$ @ $\searrow 22.6^\circ$
2. $A = 246.7 \text{ N} \leftarrow$, $D = 344$ @ $\searrow 23.2^\circ$
3. $A = 246.7 \text{ N} \rightarrow$, $D = 338.6$ @ $\searrow 23.6^\circ$
4. $A = 244 \text{ N} \rightarrow$, $D = 344.6$ @ $\searrow 22.2^\circ$
5. $A = 244 \text{ N} \rightarrow$, $D = 344.5$ @ $\searrow 22.4^\circ$



[20 marks]

Ans.

① $\Sigma F_x = 0$

$$A_x + 150 \sin 25^\circ + D_x = 0$$

② $\Sigma F_y = 0$

$$150 \cos 25^\circ - 150 \cos 25^\circ + D_y = 0 \Rightarrow$$

$$+150 \cos 25^\circ = +D_y \Rightarrow D_y = 150 \cos 25^\circ = 136 \text{ N}$$

③ $\Sigma M_D = 0 \Rightarrow$

$$-A(180) + 150 \sin 25^\circ(100) + 150 \cos 25^\circ(280) = 0$$

$$-280A + 6339.27 + 13594.61 = 0$$

$$-180A + 6339.27 + 38064.92 = 0$$

$$-180A + 44404.19 \Rightarrow A = \frac{44404.19}{180} = 246.7 \text{ N}$$

$$\therefore 246.7 + 63.39 + D_x = 0 \Rightarrow D_x = 310.1 \text{ N}$$

$$D = \sqrt{D_x^2 + D_y^2} = \sqrt{(310.1)^2 + (136)^2} = 338.6 \text{ N}$$

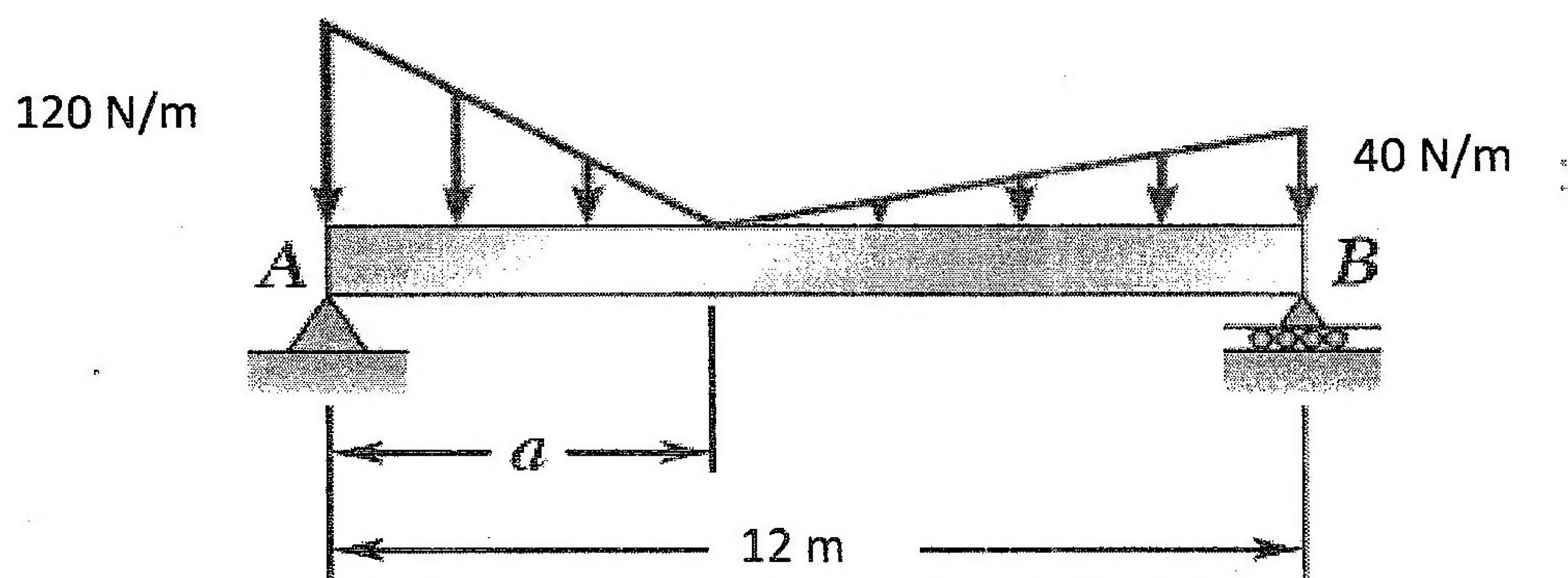
$$\phi = \tan^{-1} \left(\frac{D_y}{D_x} \right) = \tan^{-1} \left(\frac{136}{310.1} \right) = \tan^{-1}(0.4385) = 23.6^\circ$$

Section B – Answer ONE question only

QB1

A rigid slender beam AB is horizontally supported at A with a pin joint while B is simply supported with a roller as shown in the diagram below. The beam is subjected to distributed loading as shown. If the beam is in equilibrium and is assumed to have a negligible mass, determine:

- (a) The distance a so that the vertical reactions at supports A and B are equal, **[15 Marks]**
(b) The corresponding reactions at the supports. **[10 Marks]**



Ans.

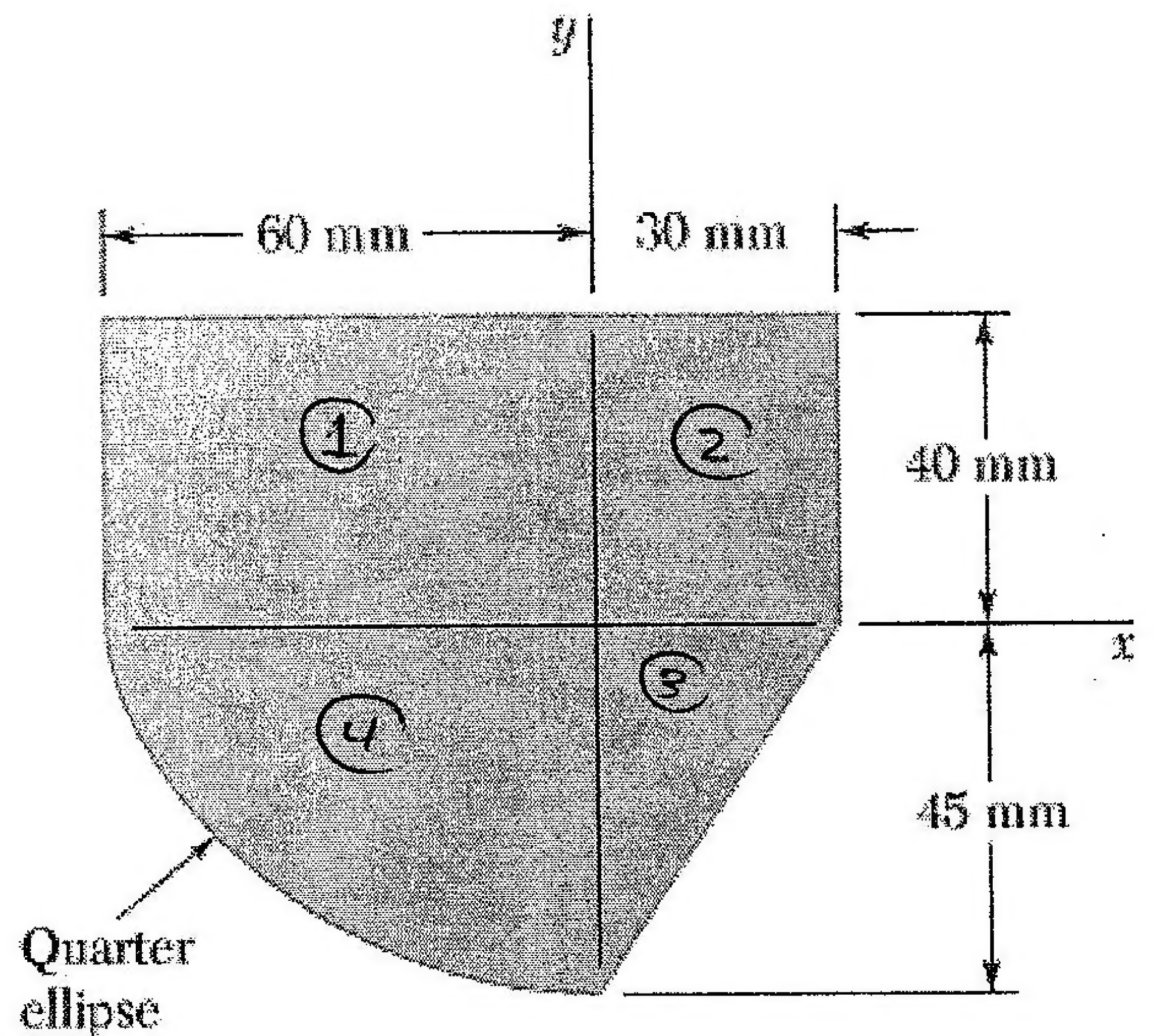
QB2

A homogeneous metal plate shaped as shown in the diagram below. If the x-y axes are set on the plate as shown, Determine (in mm):

(a) The X coordinate of the centroid of plate
[13 Marks]

(b) The Y coordinate of the centroid of the plate
[12 Marks]

[Hint: You may use the appropriate information given on the table given to you]



Ans.

Shape	Area (mm^2)	\bar{x} (mm)	\bar{y} (mm)	$\bar{x}A$ (mm^3)	$\bar{y}A$ (mm^3)
rectangle # ①	2400 (60x40)	-30	20	-72000	48000
rectangle # ②	1200 (30x40)	15	20	18000	24000
Triangle # ③	675 ($\frac{1}{2} \times 45 \times 30$)	10	-15	6750	-10125
Quarter ellipse # ④	$\frac{\pi ab}{4} = \frac{\pi (60)(45)}{4}$ = 2120.5	$\frac{4a}{3\pi} = \frac{4(60)}{3\pi}$ = 25.46	$\frac{4b}{3\pi} = \frac{4(45)}{3\pi}$ = -19.09	-53987.9	-40480.3
$\Sigma \Rightarrow$	$\Sigma A =$ 6395.5			$\Sigma \bar{x}A =$ -101237.9	$\Sigma \bar{y}A =$ 21394.7

* ~~$\bar{x} = \frac{\Sigma \bar{x}A}{\Sigma A}$~~ $\bar{x} \Sigma A = \Sigma \bar{x}A$

$\Rightarrow \bar{x} = \frac{\Sigma \bar{x}A}{\Sigma A} = \frac{-101237.9}{6395.5}$

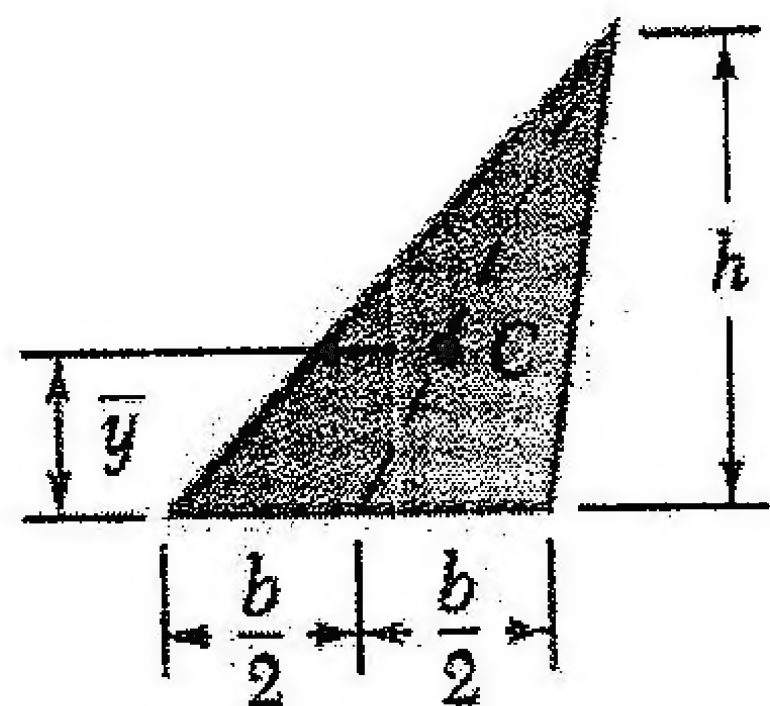
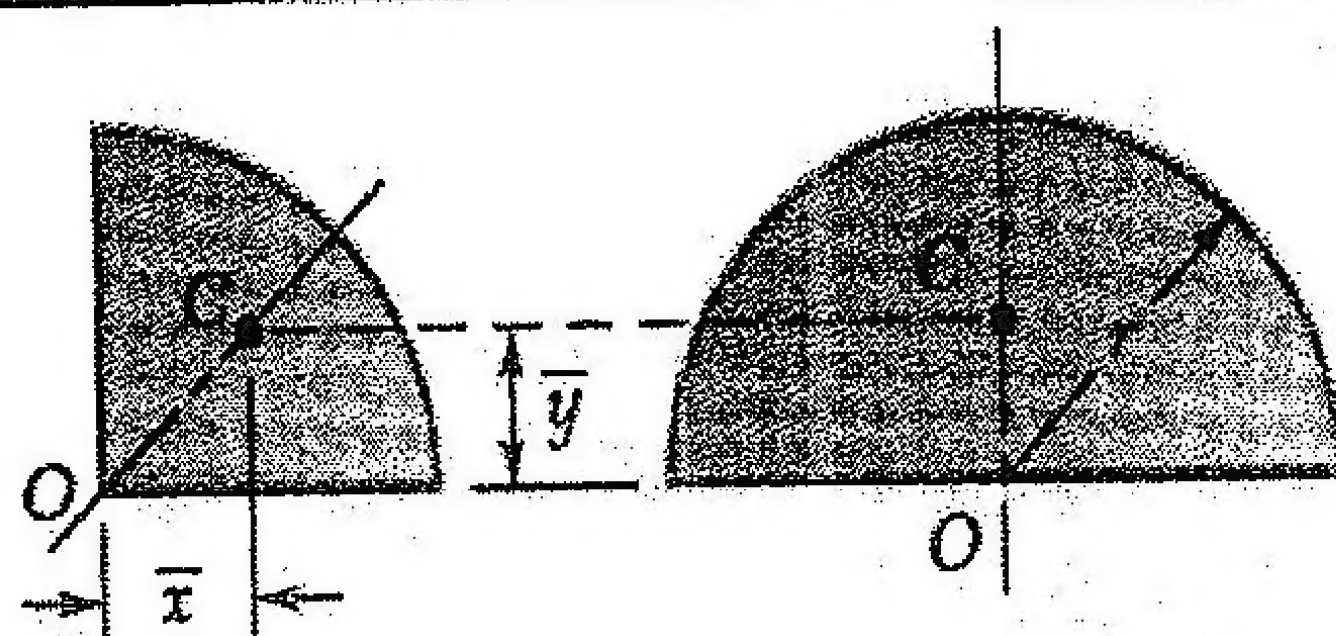
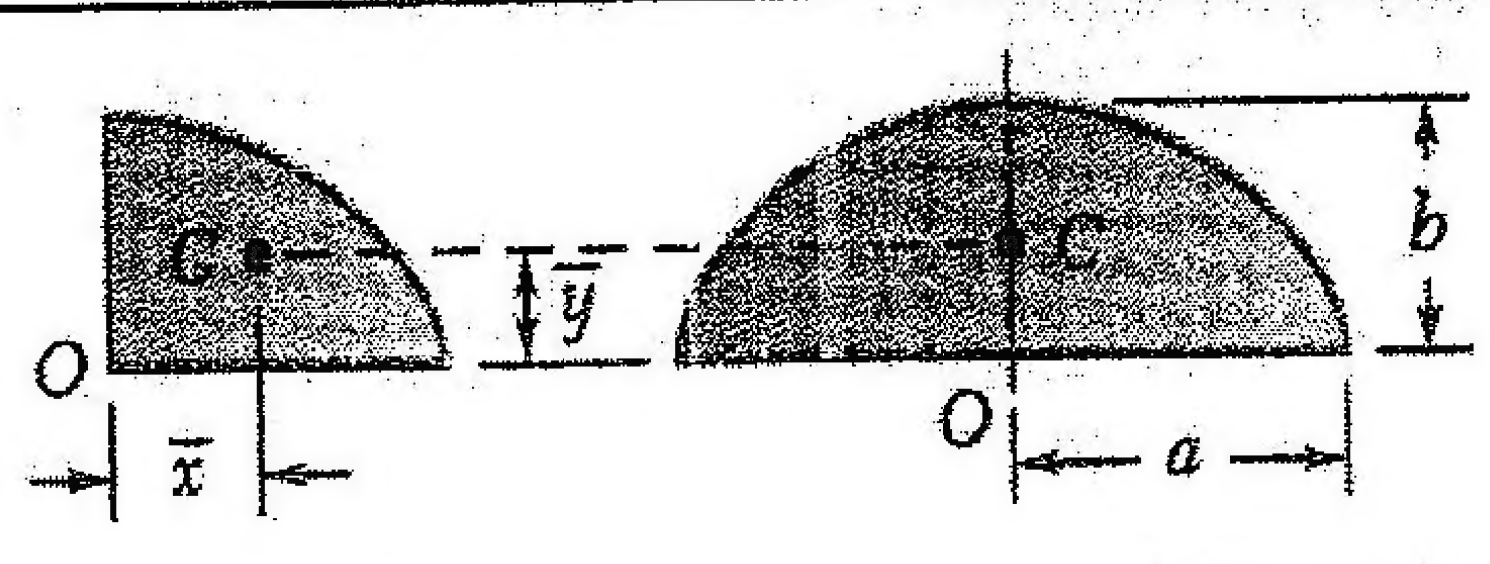
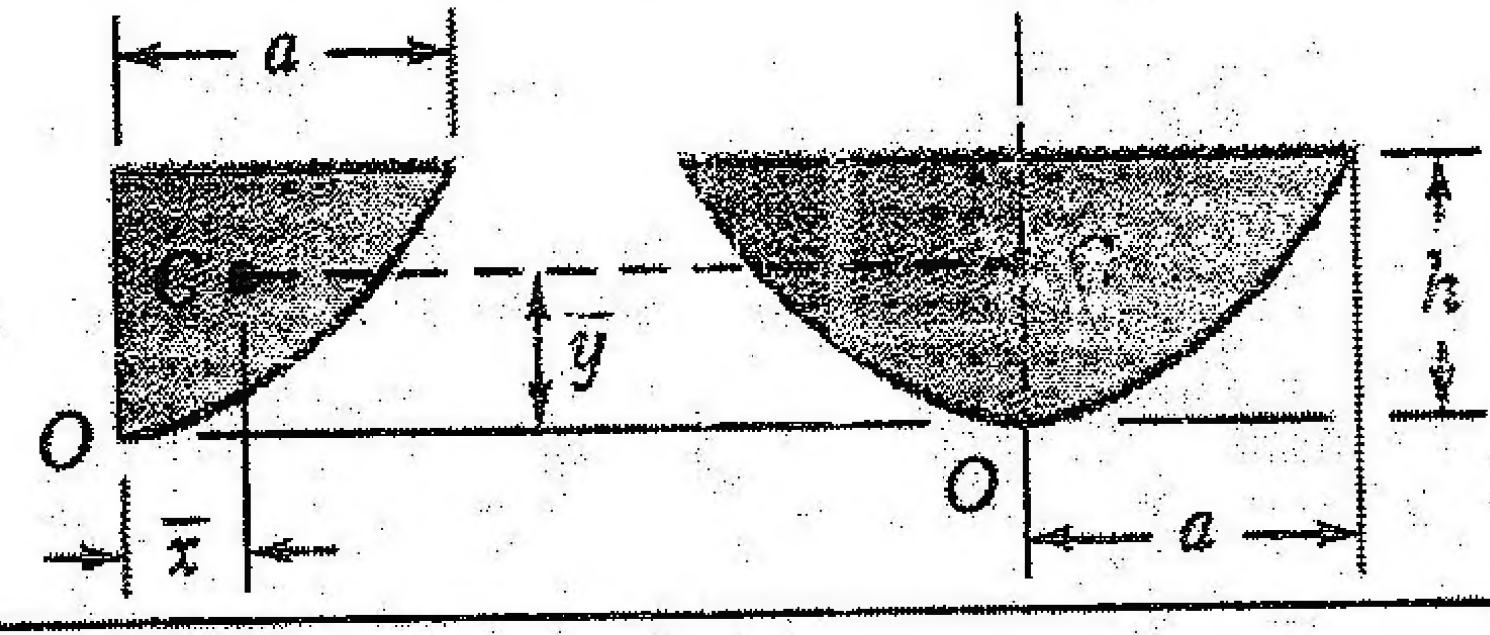
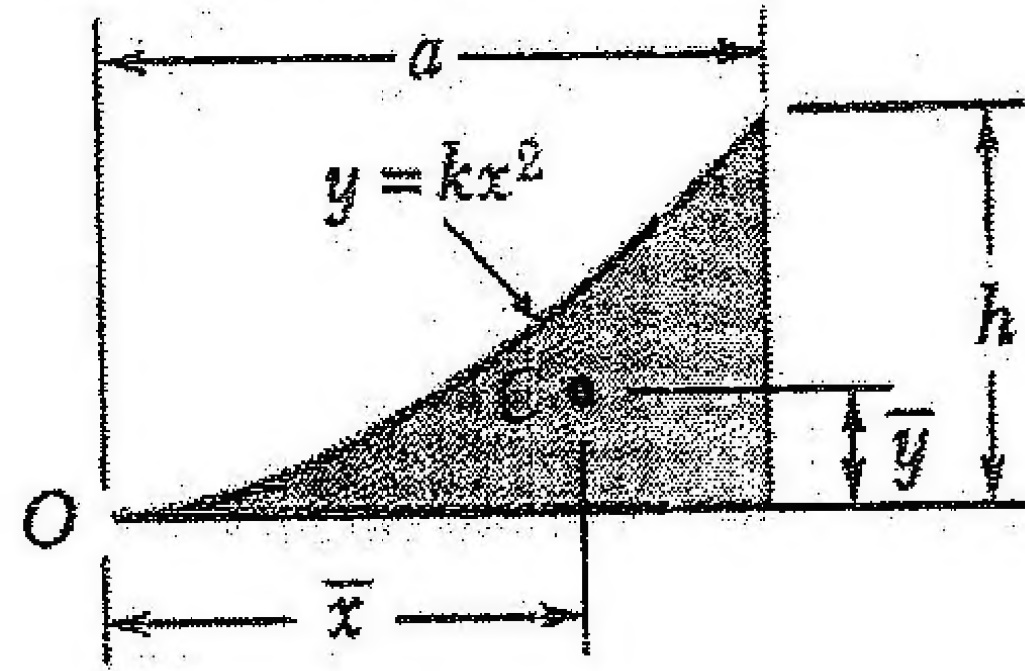
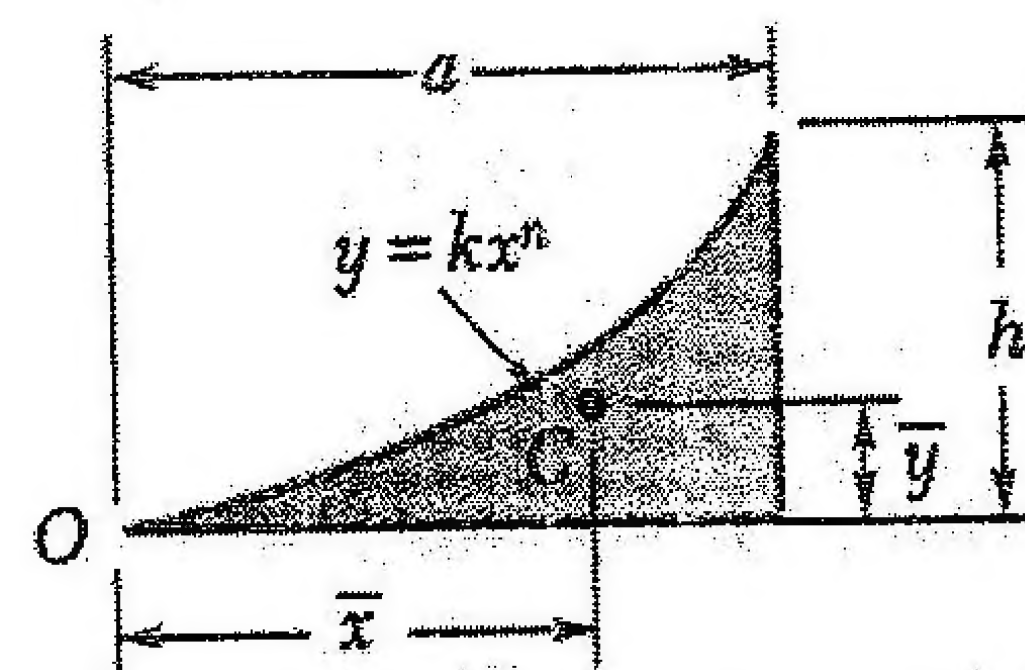
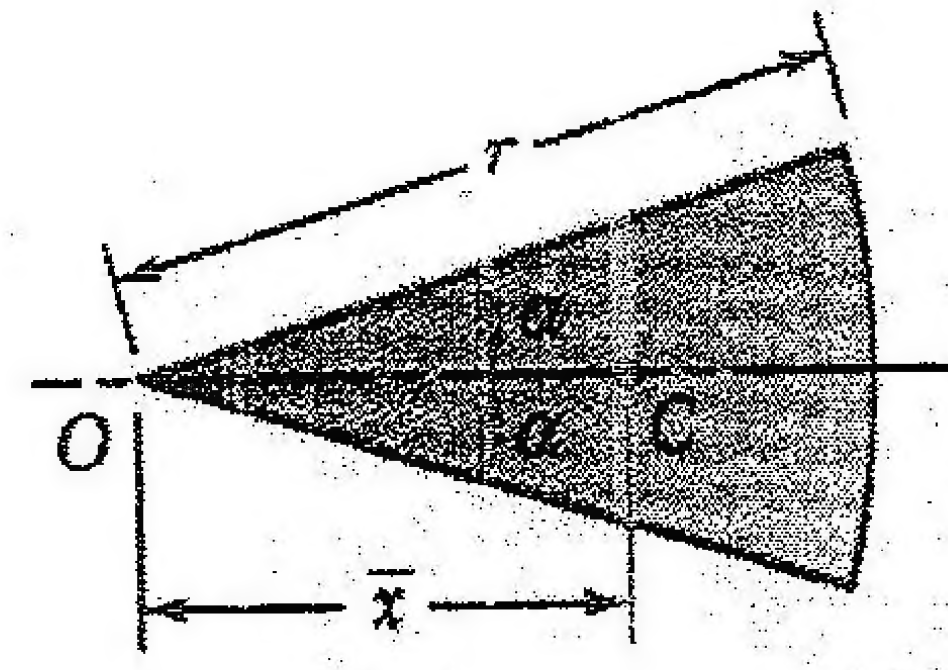
$= -15.83 \text{ mm}$

25/25

④ $\bar{y} \Sigma A = \Sigma \bar{y}A$

$\Rightarrow \bar{y} = \frac{\Sigma \bar{y}A}{\Sigma A} = \frac{21394.7}{6395.5} = 3.345 \text{ mm}$

Information Sheet – to go with Static Test 2

Shape		\bar{x}	\bar{y}	Area
Triangular area			$\frac{h}{3}$	$\frac{bh}{2}$
Quarter-circular area		$\frac{4r}{3\pi}$	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{4}$
Semicircular area		0	$\frac{4r}{3\pi}$	$\frac{\pi r^2}{2}$
Quarter-elliptical area		$\frac{4a}{3\pi}$	$\frac{4b}{3\pi}$	$\frac{\pi ab}{4}$
Semielliptical area		0	$\frac{4b}{3\pi}$	$\frac{\pi ab}{2}$
Semiparabolic area		$\frac{3a}{8}$	$\frac{3h}{5}$	$\frac{2ah}{3}$
Parabolic area		0	$\frac{3h}{5}$	$\frac{4ah}{3}$
Parabolic spandrel		$\frac{3a}{4}$	$\frac{3h}{10}$	$\frac{ah}{3}$
General spandrel		$\frac{n+1}{n+2}a$	$\frac{n+1}{4n+2}h$	$\frac{ah}{n+1}$
Circular sector		$\frac{2r \sin \alpha}{3\alpha}$	0	αr^2